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The Effects of Democratic Determination of Wages

Theory and Evidence from Self-Managed Firms

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Should workers participate in decisionmaking about pay? Democratic decisionmaking about pay — if divorced from substantive participation of workers in other areas — decreases productivity.

This paper — a product of the Transition and Macroadjustment Division, Country Economics Department — is part of a larger effort in the department to investigate the labor market in transitional economies. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact CECTM1, room N6-045, extension 37188 (August 1992, 26 pages).

Some assert that when efficiency requires cooperation, effectiveness is increased by an egalitarian pay structure resulting from workers' participation in decisionmaking about pay. But it can also be argued that equalizing pay reduces the morale of highly productive workers, and thus more than offsets the positive effects of cooperation.

To shed light on this controversy, Vodopivec explores both theoretically and empirically how productivity is affected when workers determine relative pay differences democratically (by referendum). The median voter model suggests that this kind of decisionmaking process produces an egalitarian wage structure. Using alternative assumptions about worker incentives, Vodopivec formalizes and empirically tests two competing views about how an egalitarian wage

structure affects productivity in a sample of Yugoslav firms. He finds that democratic decisionmaking about pay — if divorced from substantive participation of workers in other areas — decreases productivity.

One implication of this finding for policy-makers, particularly in Eastern Europe and the former Soviet republics, is that programs designed to allow workers to participate in pay decisions must be consistent with the workers' general involvement in decisionmaking. If participation is limited to decisions about pay, or if external control is imposed on intrafirm wage differentials (which has effects on wage distribution similar to those of worker participation), the resulting compressed wage structure is likely to produce negative effects on productivity.

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THE EFFECTS OF DEMOCRATIC DETERMINATION OF WAGES:
THEORY AND EVIDENCE FROM SELF-MANAGED FIRMS

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The World Bank

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Part of the controversy about whether workers should participate in decisionmaking involves the question of whether workers should participate in decisionmaking about pay.¹ Both theory (median voter models) and evidence (producer cooperatives, the unionized sector) support the conclusion that when workers participate in pay decisions, the range of wages in a firm narrows.² Some assert that "when efficiency requires efficient cooperation, almost any movement toward a democratic egalitarian structure increases effectiveness" (the "cooperation" argument).³ According to this argument, more equal pay increases cohesiveness, which increases productivity by improving the flow and use of information through peer pressure (Levine and Tyson 1990) and by reducing "sabotage" -- workers hindering the activity of their co-workers (Lazear 1989). But it can also be argued that equalizing pay hurts the morale of highly productive workers, which more than offsets the positive effects of cooperation (the lowering-of-morale argument).

To shed light on the controversy, this paper explores both theoretically and empirically how productivity is affected when workers determine relative pay differences democratically (by referendum). The median voter model suggests that such a determination produces an egalitarian wage structure. Using alternative assumptions about worker incentives, I formalize and

¹There is a profound controversy about the effects of worker participation in decisionmaking on productivity. Advocates of worker participation (notably, Vanek 1970) argue that it induces workers to work harder by boosting team spirit, improving morale, and reducing absenteeism, thus reducing costs of monitoring and conflict resolution. Worker participation is also believed to improve firm-specific human capital by both increasing job longevity and enhancing training of workers (Ireland and Law 1982). Among critics, Jensen and Meckling (1979) point out a control problem and Williamson (1975) point out the transaction costs arising from collective decisionmaking.

²See, for example, Freeman and Medoff (1984) on evidence of how unions affect wage equality.

³Morton Deutsch, cited in Levine and Tyson (1990, p. 211).

empirically test two competing views about how an egalitarian wage structure affects productivity, in a sample of Yugoslav firms. My major finding: that democratic decisionmaking about pay -- if divorced from substantive participation of workers in other areas -- decreases productivity.

After formalizing the two competing views about how worker participation in pay decisions affects productivity, and deriving their empirical implications (section 1), I present the estimating framework and the empirical results (section 2). I conclude with the discussion of results and their implications for policy.

1. MODELING THE EFFECTS OF WORKER PARTICIPATION IN PAY DECISIONS

To test how worker participation in pay decisions affects productivity, I assume that labor input (effective labor) depends on the incentives workers face.⁴ I derive the function of effectively provided labor under two alternative hypotheses about the effects of egalitarian wage structure: (1) that such a wage structure increases cohesiveness and hence productivity, and (2) that such a wage structure hurts morale and thus decreases the effort of the more productive workers, and hence the firms's productivity as a whole.

1.1 The cooperation argument

This line of reasoning emphasizes cooperation as an important feature of the firm. It assumes two things: (1) that a narrower wage dispersion increases cohesiveness ("the propensity to obey group norms because the approval of the group is valued" -- Levine 1991, p. 237), and (2) that greater cohesiveness increases effective labor, and hence productivity. Formally, $L = L(C(D))$, with

⁴This is a standard assumption in the literature on incentives -- for example, see Sen's pioneering contribution (1966).

$L'()$ positive and $C'()$ negative (L is effective labor, C is cohesiveness, and D is wage dispersion). Note that this argument implicitly assumes that a worker's utility depends not only on effort (e) and earnings (w) -- the standard arguments -- but on the approval of co-workers, that is, $U = U(w, e(C), C)$. Akerlof (1982) used a similar utility function, with work norms substituting for cohesiveness.

This reasoning predicts that the narrower the wage dispersion, the larger the provision of effective labor.

1.2 The lowering-of-morale argument

By contrast, the second line of reasoning emphasizes individualistic behavior and derives the labor supply from a standard utility maximization over income and leisure. It explicitly takes account of the democratic determination of intrafirm relative pay differences, and thus endogenously generates wage structure. The empirically testable prediction is that effective labor depends negatively on the ratio of the firm's mean to median earnings.

The setting

Suppose a firm has N workers who differ in productivity but are otherwise identical. Following Mueller's (1976) argument (that a significant part of a worker's effort is non-contractual), assume also that the firm's labor input, L , is the sum of contractual labor input, L_c , and non-contractual labor input, L_{nc} .⁵ Thus, $L = L_c + L_{nc}$ where $L_c = \sum_{i=1}^N x_i e_c$ and $L_{nc} = \sum_{i=1}^N x_i e_i$. The ability of worker i is denoted by x_i , the provision of the minimum effort needed to

⁵Recognizing the non-contractibility of effort as an essential characteristic of the firm is particularly important for socialist firms, for which "stick" incentives are intentionally designed out of the system (see Vodopivec 1991).

retain a job is e_c , and the provision of an above-minimum effort is e_i . (I sometimes call the product $x_i e_i$ the productivity of the i -th worker.)

Let the firm's value-added, Y , correspond to labor input except for the unit of measurement -- that is, $Y = Y_c + Y_{nc}$, where $Y_c = \sum_{i=1}^N x_i e_c$ and $Y_{nc} = \sum_{i=1}^N x_i e_i$. Moreover, to reflect the compensation policies in participatory firms, assume that the pre-tax earnings of the worker i , w_i^p , comprise two components: (1) an egalitarian, lump-sum component, c , equal across workers, and (2) an income-sharing component, y_i , equal to $x_i e_i$ (that is, equal to the worker's productivity).⁶ Accordingly,

$$w_i^p = c + y_i = c + x_i e_i \quad (1.1)$$

where

$$c = \frac{1}{N} \sum_{i=1}^N x_i e_c \quad (1.2)$$

so that the overall earnings exhaust the firm's value-added.

The egalitarian wage tendency that characterizes the democratic wage-setting environment is modeled in the following way.⁷ The income-sharing

⁶This mirrors the wage-setting practiced by Yugoslav firms in 1986: c corresponds to the earnings-in-kind component, and $x_i e_i$ to the cash-earnings component of a worker's compensation. Moreover, a worker's effort, e_i , and ability, x_i , correspond to his/her index of the quality of work and the complexity of work, respectively (see appendix 1).

⁷There is a well-documented tendency to compress differences in earnings among workers within the Yugoslav firm. According to Prasnikar and Svejnar (1988), "[v]arious measures suggest that the distribution of personal income is relatively egalitarian in Yugoslav firms," and "Yugoslav skilled workers and managers earn less relative to unskilled workers than their counterparts in

component of the worker's pre-tax earnings, $x_i e_i$, is "taxed" at the rate t ($0 \leq t < 1$) and used for financing a lump-sum subsidy, r , for each worker. The subsidy is paid out of the tax revenues, and all tax revenues are redistributed. In other words, $r = t\bar{y}$, where \bar{y} (the average of the income-sharing component of pre-tax earnings) equals Y_{nc}/N . The redistribution mechanism is the same as for a progressive linear income tax. The net subsidy per worker is equal to $t(\bar{y} - x_i e_i)$, which means that the net subsidy is positive for workers who work below the mean level of productivity and negative for workers who work above it. One can justify such a concept on the grounds that it captures two basic features of real-world intrafirm redistribution: (1) the redistribution is from richer to poorer (and so compresses the structure of personal earnings), and (2) it preserves the order of personal earnings.

Taking account of intrafirm redistribution, the earnings of the worker with ability x_i are equal to:

$$\begin{aligned} w_i &= w_i^p + r - tx_i e_i \\ &= r + c + (1 - t)x_i e_i \end{aligned} \quad (2)$$

The effects of compressed wage differentials on effective labor (value-added)

To model the effects of compressed wage differentials on productivity within a standard utility maximization framework, I modify the median voter model of Meltzer and Richard (1983), which employs a Stone-Geary utility function:⁸

capitalist firms" (p. 279). Similarly, Flakierski (1989) finds that, in Yugoslavia, "interskill differentials are quite small by Western standards and smaller than in many socialist countries" (p. 75).

⁸Like Meltzer and Richard, I assume that the distribution of income is positively skewed.

$$u(w, \ell) = \ln(w + \omega) + a \ln(\ell + \lambda); \quad a, \omega, \lambda > 0 \quad (3)$$

where ℓ is leisure, and ω and λ are the parameters of the utility function.

Each worker takes the parameters r , t , and c as given and chooses e_i to maximize his utility. Substituting (2) into (3), maximizing (3), and setting $\ell = 1 - e$, yields

$$\max_{\{e_i\}} u(w_i, 1 - e_i) = \max \left[\ln(\omega + r + c + (1 - t)x_i e_i) + a \ln(1 - e_i + \lambda) \right]. \quad (4)$$

Differentiating (4) with respect to e_i we get

$$\frac{x_i (1 - t)}{\omega + r + c + (1 - t)x_i e_i} - \frac{a}{1 - e_i + \lambda} = 0 \quad (5)$$

and solving for e_i we have

$$e_i = \frac{(1 + \lambda)(1 - t)x_i - (\omega + r + c)a}{(a + 1)(1 - t)x_i} \quad \text{for } x_o > x \quad (6.1)$$

$$e_i = 0 \quad \text{for } x \leq x_o \quad (6.2)$$

$$\text{where } x_o = \frac{(\omega + r + c)a}{(\lambda + 1)(1 - t)}. \quad (7)$$

The ability of the most productive worker, among those who opt not to provide more than the minimum effort, e_o , is denoted by x_o . I call this worker the i_o -th worker.

On the basis of the supply-of-effort functions (6), we can obtain the following comparative statics result:⁹

Proposition 1: *Increasing the intrafirm tax rate t has a negative*

⁹Proofs of this and the following proposition are given in appendix 2.

effect on the firm's effectively provided labor (value-added) -- that is, decreases the size of the pie.

Unfortunately, this intuitively appealing result does not lend itself to empirical verification: the intrafirm tax rate, \underline{t} , is unobservable. By exploiting the fact that relative earnings (and hence the tax rate) are determined by majority rule, however, we can link the tax rate to an observable variable -- the task we turn to now.

Linking intrafirm redistribution to an observable variable

The modeling of intrafirm redistribution as a simple tax-subsidy scheme reduces the issue of redistribution to two dimensions: a per capita subsidy, \underline{r} , and an intrafirm tax rate, \underline{t} . If we require that tax revenues equal the subsidies paid out, we can determine only one of these variables independently. I use the tax rate \underline{t} as the choice variable. Exploiting democratic wage setting (such as prevailed in Yugoslav firms -- see appendix 1), we then invoke a median voter theorem, that the median voter decides.¹⁰

Note the balanced budget, $r = t\bar{y}$, remember the budget constraint (2), and denote the income-sharing component of the median worker's pre-tax earnings with y_d ($y_d = x_d e_d$). This yields the following maximization for the median worker:

$$\max_{\{t\}} u(w_d, 1 - e_d) = \max_{\{t\}} \left[\ln \left(\omega + t\bar{y} + c + (1 - t)y_d \right) + a \ln(1 - e_d + \lambda) \right] \quad (8)$$

The first-order condition is:

$$\bar{y} + t \frac{d\bar{y}}{dt} - y_d = 0 \quad (9)$$

¹⁰For a discussion of the median voter theorem, see, for example, Mueller (1989).

since by the envelope theorem the coefficient of the de_d/dt term, $\delta u/\delta e_d$, is zero (e_d is the outcome of utility maximization).

To balance the budget, higher taxes are needed to increase the subsidy. The median voter thus faces the following trade-off (embedded in equation 9): by imposing a higher tax rate, he/she is better off through the higher subsidy \underline{r} (which is proportional to \underline{t}). But increasing the tax rate has also an indirect effect: decreasing the size of the pie, as stated in proposition 1, which makes the median voter worse off.

By using the equilibrium condition (9), we arrive at the following relationship (see appendix 2), linking the tax rate to an observable variable:

Proposition 2: *The higher the mean of the income-sharing component of the workers' pre-tax earnings, compared with the income-sharing component of the median worker's pre-tax earnings, the higher the equilibrium tax rate, \underline{t} .*

This proposition can be reinterpreted as follows. With the intrafirm redistribution scheme adopted in the model, the structure of post-tax earnings corresponds to the structure of pre-tax earnings, so it also reflects the structure of workers' productivity. The proposition thus says that the lower the productivity of the median worker, compared with the firm's mean productivity, the more the median worker can gain by imposing a higher tax rate (or, loosely speaking, a greater redistribution of income within the firm).

Combining propositions 1 and 2 produces the following corollary.

Corollary 1: *The higher the mean of the income-sharing component of the workers' pre-tax earnings, compared with the income-sharing component of the median worker's pre-tax earnings, the lower the firm's effectively provided*

labor (value-added).

Finally, what was the policy instrument through which the median voter implemented redistribution in the Yugoslav firms? It was the wage scale, determined by a referendum of workers under majority rule (see appendix 1). With the optimal intrafirm tax rate in mind, the median worker set the scale so as to produce the desired redistribution. The worker accomplished that by compressing the wage scale -- shrinking the index of work complexity (I_1^C , see appendix 1) for workers whose productivity was above-average, and increasing the index for workers with below-average productivity.¹¹

2. EMPIRICAL RESULTS

To test the two competing hypotheses about the effects of worker participation in pay decisions, I estimated an augmented production function for a sample of Yugoslav firms, with the augmenting variables that determine effective labor dictated by the above theory. I postulated that effective labor depends not only on the number of workers, but also either positively on wage dispersion (the cooperation argument) or negatively on the ratio of the firm's mean to median earnings (the lowered-morale argument).¹² Note that

¹¹The resulting post-redistribution distribution of cash earnings was thus $\hat{D} = \{e_i x_i + (\bar{y} - x_i e_i)t \equiv e_i x_i \sigma_i, i = 1, \dots, N\}$, compared with the distribution without redistribution, $D = \{e_i x_i, i = 1, \dots, N\}$, where σ_i is the compression coefficient associated with the wage index of the worker with ability x_i . The compression coefficients, σ_i -s, are defined as $\sigma_i = 1 + \frac{(\bar{y} - x_i e_i)t}{e_i x_i}$, $i = 1, \dots, N$ (note that $\sigma_i \geq 1$ as $\bar{y} \geq x_i e_i$).

¹²In the empirical test, wage dispersion is normalized by a dispersion of skills, to control for differences in skill dispersion across firms. I also take the ratio of the mean to the median actual (that is, after-tax) personal earnings as a proxy for the ratio of mean to median income-sharing component

the theory provides a rationale for using the augmented variables (wage dispersion and the ratio of mean to median earnings) in a labor-embodied fashion. By estimating a production function, of course, the effects of the compressed wage structure on effectively provided labor are identified only indirectly, by how they affect value-added, so other determinants of value-added are carefully controlled for.

In general, the production function to be estimated can be written as

$$Y = f\left(K, L(N, D, m, Z_1)\right)g(Z_2) \quad (10)$$

where Y is value-added; K is capital; L is effectively provided labor, N is the number of workers; D is wage dispersion (normalized by skills dispersion), m is the ratio of the firm's mean to median earnings; and Z_1 and Z_2 are embodied and disembodied control variables, respectively.

The choice of the functional forms for the functions in (10) was based on the following considerations. First, the complexity of the term representing effectively provided labor dictated the use of the simplest functional form for the function $f(\)$ -- the Cobb-Douglas one.¹³ Second, the functional form for the effectively provided labor was selected on an experimental basis, choosing between the form where the number of workers interacted with other variables in a multiplicative way, and the form where that interaction was additive. (The first form was selected; the estimation of the second did not

of pre-tax earnings (the rationale being that the intrafirm redistribution scheme preserves the correspondence between the structure of pre-tax and after-tax earnings).

¹³Prasnikar, Svejnar and Klinedinst (1992) find Cobb-Douglas specifications of production function superior to CES and trans-log one for Yugoslav firms during 1975-9.

converge.) Third, as is standard in the literature, an exponential function was adopted for disembodied control variables, that is, for the function $g(\cdot)$.

As for the choice of the control variables, the following two were used in the labor-embodied fashion: (1) the average number of years of education of the workforce (EDUC), to adjust for differences in skills acquired through education, and (2) labor turnover (TURN), to control for differences in skills because of "asset specificity" -- the longer the workers stay in the firm, the more firm-specific knowledge they acquire, and (other things being equal) the more productive they become.

A more complex version of the above model allows for another interpretation of the link between labor turnover and value-added, the interpretation based on cooperation among workers. Assuming that a worker's effort depends on his co-workers' effort, one can show that the equilibrium effort of each worker is positively associated with the "team spirit" -- more precisely, with the sum of changes in co-workers' effort in response to a change in effort of one of them.¹⁴ If one is willing to interpret labor turnover as a proxy for the team spirit (presumably, the higher the team spirit, the lower the turnover), the cooperative link between labor turnover and value-added follows.

Two groups of disembodied control variables were included in the equation. One group consisted of variables that affected value-added through output and input prices: (1) the firm's market share (MSHARE), as proxy for monopoly power; (2) the share of exports in the firm's output (EXPSHARE), reflecting exchange rate policies; and (3) industry dummies (DUM), to control

¹⁴The proof of this proposition is available to the interested reader, on request.

for different price regimes across industries (which might have affected both input and output prices). (The positive association of the export share with value-added could also indicate that export-oriented firms were more efficient.)

The other group of disembodied control variables addressed efficiency in setting the "boundary of the firm" (in the sense of Coase 1937) -- that is, efficiency of production organized as a hierarchy compared with production coordinated through prices. Yugoslav firms differed in organizational structure regarding vertical integration, and these differences might have contributed to differences in their performance.¹⁵ Therefore, two additional control variables were included in the estimated equation: the unit's membership in a so-called Working Organization of Associated Labor (WOAL) and its membership in a so-called Composite Organization of Associated Labor (COAL).

Based on the above, the following augmented production function was estimated in its logarithmic transformation:

$$Y = AK^{\alpha} \left(N(1 + a_1 D + a_2 m + a_3 EDUC + a_4 TURN) \right)^{\beta} e^{a_5 MSHARE + a_6 EXPSHARE + a_7 WOAL + a_8 COAL + \sum_{i=9}^{i=26} a_i DUM_i} \quad (11)$$

¹⁵Under the system of Associated Labor that prevailed in Yugoslavia during 1974-88, decisionmaking within the firm involved up to three layers of the hierarchy. The lowest-level units were Basic Organizations of Associated Labor (BOALs). The mid-level units were Working Organizations of Associated Labor, typically consisting of several BOALs. Under certain circumstances, however, Working Organizations of Associated Labor did not comprise BOALs (the so-called Uniform Working Organizations); in those units, decisionmaking was not delegated to a lower level. Top-level units were Composite Organizations of Associated Labor, with Working Organizations of Associated Labor as members (membership was voluntary). See Prasnikar and Svejnar (1988) for details.

(A , α , β and a_1 are parameters to be estimated; other symbols are explained above). To repeat, the main variables are wage dispersion (D) and the ratio of firm's mean to median earnings (m).

The empirical results show that worker participation in pay decisions has a negative effect on productivity (see the first two columns -- representing alternative specifications -- of table 1).¹⁶ Above all, the ratio of the firm's mean earnings to its median personal earnings negatively affects value-added (highly significantly), thus supporting the lowering-of-morale argument. Moreover, the *positive* (though only weakly significant) value of the coefficient of wage dispersion not only refutes the cohesiveness argument but provides additional support that the compression of the wage structure is counterproductive.

Estimates of elasticities suggest that the economy operates at decreasing returns of scale (the sum of capital and effectively provided labor elasticities is .82), which is similar to the result found by Prasnikar, Svejnar, and Klinedinst (1992). Among the control variables, only the market share (apart from industry dummies) proved to be significant and of the expected positive sign, suggesting that monopoly affects prices. Other variables were insignificant (except for education, they are dropped in the second column), but the estimates do suggest a weak positive effect from skill specificity (through the variable $TURN$) and a negative effect from the existence of a COAL-level hierarchy (possibly through restrictive trade practices).

¹⁶ Nonlinear estimation was used, with capital and the number of workers instrumented by other right-hand-side variables and lagged values of capital and number of workers. Definitions of the variables, their summary statistics, and data sources are given in appendix 3.

TABLE 1
ESTIMATES OF THE AUGMENTED PRODUCTION FUNCTION

	(1)	(2)	(3)
Wage dispersion (D)	.151 ⁺ (1.84)	.119 ⁺ (1.78)	-.177 (-.67)
Mean-to-median earnings (m)	-.888 ^{**} (-4.26)	-.848 ^{**} (-5.10)	-.970 [*] (-2.08)
Education (EDUC)	.045 (.92)	.028 (.85)	.129 (.76)
Labor turnover (TURN)	-.019 (-1.53)	—	-.036 (-.88)
Market share (10 ² *MSHARE)	3.565 ^{**} (4.47)	3.652 ^{**} (4.55)	3.655 ^{**} (4.17)
Export share (10 ² *EXPSHARE)	-.070 (-.46)	—	.160 (.71)
Membership in a WOAL (WOAL)	.037 (.61)	—	-.063 (-.90)
Membership in a COAL (COAL)	-.090 (-1.61)	—	-.094 (-1.30)
Effective labor (L)	.551 ^{**} (7.72)	.554 ^{**} (7.80)	.517 ^{**} (6.06)
Capital (K)	.273 ^{**} (5.28)	.265 ^{**} (5.11)	.298 ^{**} (5.35)
INTERCEPT	3.817 (9.55)	3.968 (10.88)	3.641 (5.94)
R ²	.849	.846	.906
Number of observations	394	394	213

Notes: Among the variables in the first column appears also L, the effectively provided labor -- the expression in big brackets of (11), with β as the corresponding coefficient. The values in parentheses are t-statistics. Variables significant at 1 percent are marked with two asterisks, those significant at 5 percent with one asterisk, and those at 10 percent with a plus. Industry dummies are included, but their coefficients are not reported (the excluded industry is printing). Only four of them -- drawn and rolled steel, cast metal products, paper and paper products, and the manufacture of cotton fabrics -- deviated from a common intercept at 1 percent significance.

These results suggest that worker participation in pay decisions, in general, decreases productivity. It is possible that for a subset of firms -- call them "participatory" firms -- such effects may have been less pronounced. One attempt to identify such firms is to hypothesize that worker decisionmaking about pay increases cohesiveness only if workers are also substantially involved in other areas of decisionmaking (the "guaranteed individual rights" argument of Levine and Tyson 1990). By assuming that workers in such firms spend less time on sick leave (so we use sick leave as a proxy for absenteeism), I identified such firms as those with below-average rates of sick leave. The estimation results in the third column of table 1 refer to this group of firms. In contrast to the estimates for the whole sample, the wage dispersion coefficient is negative (though insignificant), thus suggesting that cooperation may have indeed played a larger role for this subsample.

Calculations show that the value-added forgone because of the negative effects on productivity of an egalitarian wage structure amounts to 4.34 percent.¹⁷ Compared with estimates of welfare loss from monopoly, this is a significant effect, providing support to Leibenstein's (1966) claim that X-inefficiency losses are much larger than losses arising from monopoly.¹⁸

¹⁷This result was obtained from the equation (11), by comparing value-added generated under the true value of the mean-to-median earnings with the value-added under the hypothetical case where mean-to-median earnings takes the value of one (in that case, the median voter model suggests that there would be no wage compression). Calculations were performed at the sample mean (except for K, for which the sample mean for log(K) was used; industry dummies were dropped).

¹⁸With few exceptions, studies of the U.S. economy -- including the pioneering Harberger's (1954) study -- find welfare losses attributable to monopoly of a very low magnitude (about 0.1 percent of GNP).

3. CONCLUDING REMARKS

In a recent overview of evidence on the effects of worker participation in decisionmaking on productivity, Levine and Tyson (1990) cautiously note that "[p]articipation usually has a positive, often small, effect on productivity, sometimes a zero or statistically insignificant effect, and almost never a negative effect" (p. 183). Literature on organization development (for example, Lawler 1981) also takes an optimistic view of the effects of worker participation in pay decisions. But researchers agree that many questions still await an answer: For example, is successful participation representative or direct? Consultative or substantive? Formal or informal? Does it cover a wide range of issues (layoffs, investment, pay system, safety), or focus narrowly on organization of the work and quality control? And, most important, do various aspects of participation interact?

This paper provides evidence that worker decisionmaking about pay can have a negative impact on productivity. So what went wrong in the Yugoslav case? Levine and Tyson (1990) argue that the recognition that workers have a say in control of the firm is a basic feature that explains the success of participatory firms (p. 205). One plausible interpretation of this paper's empirical results -- corroborated by the above result on "participatory firms" -- is that in Yugoslav firms some essential ingredients of successful participation were missing. Indeed, many agree that under the Yugoslav self-management, because of extensive government intervention in firms' decisionmaking and because of the hierarchical distribution of power within firms, workers controlled the enterprise on paper, but much less so in reality; possibly because of detailed, highly formalized procedures, decisionmaking about the relative wage structure was the exception, not the

rule.¹⁹ Workers' direct decisionmaking was limited to a few areas, and representative participation might not have allowed for the effective participation of most workers.²⁰

One implication of the paper for policymakers, particularly in Eastern Europe and the ex-Soviet republics, is that programs designed to allow workers to participate in pay decisions must give them full participation in decisionmaking. If participation is limited to decision about pay, or if external control is imposed on intrafirm wage differentials (having similar effects on wage distribution as worker participation), the resulting compressed wage structure is likely to produce negative effects on productivity.²¹

¹⁹On the workers' lack of substantive control of the firm workers see Obradovic (1978), Prasnikar and Svejnar (1990), and Kraft and Vodopivec (1992), among others.

²⁰Tyson and Levine (1990, pp. 205-14) identify four characteristics of successful participatory schemes: profit- or gain- sharing; job security and long-term employment; measures to build group cohesiveness (under which they emphasize pay equality); and guaranteed individual rights (as a means to achieve a substantive participation in decisionmaking). While job security, pay equality, and, to some degree, profit-sharing can be found in Yugoslav firms, the absence of independent judicial system and independent trade unions worked against the fourth above-mentioned characteristic -- guaranteed individual rights.

²¹In Slovenia, for example, 1991 legislation limits wage differences in social enterprises to a 15-to-1 range. Even in the U.S.A., there has been a suggestion to narrow intrafirm wage differences administratively (recently congressman Martin O. Sabo proposed taxing that part of managers' salaries that exceeds 25 times the wages of the least paid worker -- Business Week, March 30, 1992).

APPENDIX 1: HOW WORKERS' EARNINGS WERE DETERMINED IN YUGOSLAV SELF-MANAGED FIRMS

The Law of Associated Labor (LAL), which regulated wage determination in Yugoslav firms in 1986, specified that workers share the firm's income, and that their earnings consist of two components: cash earnings and earnings in kind (the second, typically smaller, component included such items as subsidized housing and free meals). The purpose of the two-component compensation was to distribute firm income according to work (the principle used in distributing the firm's cash earnings), as well as on the basis of "solidarity" (the principle used in distributing the firm's collective consumption fund -- LAL, Art. 126).

Workers' cash earnings were determined by both the quality and quantity of their work.²² The quality of work was evaluated either "objectively" (by work norms and standards) or "subjectively" (by a supervisor's evaluation of an individual's performance). The quantity of work was determined, above all, by the complexity of labor provided, which was calculated on the Marxian concept of "simple" and "complex" types of labor.²³ An index of complexity (defined as the number of units of simple labor required for a unit of complex labor) was assigned to each job in a firm, thus creating a wage scale for the firm.²⁴ (In the model, e_i corresponds to the quality, and x_i to the complexity of labor.)

²²See, for example, Schrenk (1981).

²³Workers typically worked the same number of hours because of rigid employment rules (Vodopivec 1991). This made duration of work, the other determinant of the quantity of work, unimportant.

²⁴Four criteria were taken into account: the worker's capability, the amount of responsibility involved, the physical strain required of the worker, and environmental effects on the worker (for more details, see Vodopivec 1989).

Workers determined the firm's wage scale by referendum -- a feature that is central to the theoretical model constructed above. The proposed wage scale was subject to a debate in the firm and was voted on by simple majority rule (LAL, Art. 463). Evaluations of quality of work among workers did not vary a lot, so the wage scale was the most important determinant of earnings for all workers, including managers.

The following wage scale of a Slovenian manufacturing firm shows the compression of wage differentials in the Yugoslav firm in 1986 (for example, a plant manager's pay was only 3 times the pay of a plastic-filer):²⁵

Description of Work Position	Degree of Complexity
1. Simple filing off the excess plastic from finished products	1.00
2. Producing of metal foil cans	1.22
3. Cutting foil	1.25
4. Running the printing and painting machine	1.28
5. Transporting	1.31
6. Producing intermediate products	1.34
7. Carrying out less demanding installation	1.38
8. Driving electric fork lift	1.42
9. Administering a warehouse	1.46
10. Collecting and manipulating data	1.52
11. Simple product accounting	1.60
12. Simple metalwork	1.70
13. Complicated invoicing	1.83
14. Demanding metalwork	1.96
15. Supervising of a work group	2.09
16. Very demanding metalwork	2.24
17. Supervising a shift	2.38
18. Preparing and controlling technological processes	2.53
19. Buying on foreign markets	2.68
20. Most demanding product design	2.83
21. Managing a bigger plant	2.99
22. Managing a group of designers	3.15
23. Researching and designing construction elements	3.34
24. Managing a production division	3.54

²⁵Wage range in Mondragon cooperatives has been similar to the range presented here. Bradley and Gelb (1985) report a range of 1:4.5 (after including special bonuses), significantly below the range outside the cooperatives.

Description of Work Position	Degree of Complexity
25. Managing a division	3.75
26. Managing a Basic Organization of Associated Labor	3.95
27. Managing a Working Organization of Associated Labor	4.54

Technically, earnings in self-managed Yugoslav firms were determined in the following way. First, the performance score of the i -th worker (T_i) was obtained as

$$T_i = I_i^C \times I_i^Q \times H_i$$

where I_i^C is the index of the complexity of labor of the i -th worker as determined by the job scale, I_i^Q is the index of the quality of labor of the i -th worker, and H_i is the number of hours worked by the i -th worker. Second, the i -th worker's cash earnings (W_i) were obtained as

$$W_i = \frac{T_i}{\sum_1 T_i} \times \text{WBILL}$$

where WBILL is a the firm's fund earmarked for cash earnings, and $\frac{T_i}{\sum_1 T_i}$ the i -th worker's share in it.

APPENDIX 2: PROOFS OF PROPOSITIONS

Proof of Proposition 1

Let us denote $F(x_0) = \frac{1_0}{N}$ as the share of workers who do not provide non-contractual contributions of effort and information. Note that $0 \leq F(\cdot) < 1$ (in a non-trivial case when at least some of the workers are contributing non-contractual effort). Modifying the result from Meltzer and Richard (1983, p. 408)) -- the budget constraint in the model above includes an additional

lump-sum term, \underline{c} -- we have

$$\frac{d\bar{y}}{dt} = - \frac{a(1-F)(\bar{y} + c + \omega)}{(1-t)[(1+a)(1-t) + a(1-F)t]} \quad (A1)$$

This expression is negative because all of the multipliers of the ratio on the right-hand side are positive. QED

Proof of Proposition 2

Meltzer and Richard (1983, p. 409) show that the tax rate, \underline{t} , can be approximated by

$$t = \frac{(1+a)(m-1)}{a(1-F)(1+g)} \quad (A2)$$

where $m = \frac{\bar{y}}{y_d}$, and $g = \frac{\omega + c}{y_d} > 0$ ($y_d = x_d e_d$, where subscript d refers to the decisive worker). The latter term takes account of the modified budget constraint. We want to show that $\frac{dm}{dt} > 0$.

Let us first show that $\frac{de_1}{dt} \leq 0$. For $x_1 \leq x_0$, it follows from (6.2) that $\frac{de_1}{dt} = 0$. For $x_1 > x_0$, total differentiation of (6.1) gives

$$\begin{aligned} \frac{de_1}{dt} &= \frac{d}{dt} \left(\frac{(1+\lambda)(1-t)x_1 - (\omega + t\bar{y} + c)a}{(a+1)(1-t)x_1} \right) = \\ &= - \frac{a\left(\bar{y} + t\frac{d\bar{y}}{dt}\right)(1-t) + a(\omega + c + t\bar{y})}{(1+a)x_1(1-t)^2} = - \frac{a\left(\bar{y} + t(1-t)\frac{d\bar{y}}{dt} + \omega + c\right)}{(1+a)x_1(1-t)^2} \end{aligned}$$

Substituting (A1) in the above expression,

$$\begin{aligned} \frac{de_1}{dt} &= - \frac{a\left(\bar{y} + \omega + c - t(1-t) \frac{a(1-F)(\bar{y} + c + \omega)}{(1-t)[(1+a)(1-t) + a(1-F)t]}\right)}{(1+a)x_1(1-t)^2} \\ &= - \frac{\frac{(1+a)(1-t) + a(1-F)t - a(1-F)t}{(1+a)(1-t) + a(1-F)t} a(\bar{y} + c + \omega)}{(1+a)x_1(1-t)^2} \end{aligned}$$

$$\begin{aligned}
&= - \frac{\frac{(1+a)(1-t)}{(1+a)(1-t) + a(1-F)t} a(\bar{y} + c + \omega)}{(1+a)x_1(1-t)^2} \\
&= - \frac{a(\bar{y} + c + \omega)}{(1-t)[(1+a)(1-t) + a(1-F)t]x_1} < 0 \quad (A3)
\end{aligned}$$

The final expression for de_1/dt is negative because all the terms of the ratio are positive.

Let us show now that $\frac{dm}{dt} > 0$. The logarithmic derivation of (A2) gives

$$\frac{1}{t} = \frac{1}{m-1} \frac{dm}{dt} + \frac{1}{1-F} \frac{dF}{dt} - \frac{1}{1+g} \frac{dg}{dt} \quad (A4)$$

Further manipulations and substitution for g yield

$$\begin{aligned}
\frac{t}{m-1} \frac{dm}{dt} &= 1 - \frac{t}{1-F} \frac{dF}{dt} + \frac{t}{1+g} \frac{d}{dt} \left(\frac{\omega + c}{x_d e_d} \right) = \\
&= 1 + \frac{d \ln(F-1)}{d \ln t} + \frac{t(\omega + c)}{(1+g)x_d e_d^2} \left(- \frac{de_d}{dt} \right) \quad (A4)
\end{aligned}$$

Note that the coefficient of $\frac{dm}{dt}$, $\frac{t}{m-1}$, is positive (in the non-trivial case of $t > 0$, $m > 1$). By (A3), the provision of non-contractual effort decreases as the tax rate increases, so F , the proportion of workers who do not make non-contractual contributions, increases with the tax rate, t . Thus, the second term on the right-hand side of (A4) is positive, and so is the last term, since $\frac{de_d}{dt}$ is negative by (A3). QED

APPENDIX 3: DATA AND VARIABLES USED IN THE EMPIRICAL ANALYSIS

The empirical analysis is based on the sample of 403 Slovenian manufacturing firms, for 1986. To allow for industry-level analysis, only industries (defined at the lowest, 5-digit level) with 10 or more firms were

included in the sample, together accounting for approximately 10 percent of Slovenian Gross Material Product.²⁶

The average firm in the sample employs about 250 workers, and has a market share of 4 percent (see table A1) -- so the firms are large from the viewpoint of market economies, and small from the viewpoint of other Eastern European and Soviet economies. The average capital-output ratio of the sample is a rather low 0.84. Most firms (83 percent of them) are Basic Organizations of Associated Labor; the rest are Uniform Working Organizations. Forty-five percent of them are members of Composite Organizations of Associated Labor.

The variables used in the empirical analysis are defined as follows:

- Y -- net value-added of the firm (revenues minus costs, with costs including depreciation but not wages), in millions of 1986 dinars.
- K -- capital (current value of fixed assets in use at the end of the year), in millions of 1986 dinars.
- N -- number of workers (yearly average of the end-of-the-month number of workers).
- D -- dispersion of wages (the coefficient of variation of wages divided by the coefficient of variation of the average duration of the professional education of workers, times one hundred).
- m - the ratio of the mean to median personal earnings of the firm (computed from the data on the number of workers falling in 14 personal earnings brackets as of March 1986).
- EDUC -- average number of years of education of the workforce (in years).
- TURN -- labor turnover (the sum of separations and hirings as a percentage of the total number of workers of the firm, as of March 1986).
- MSHARE -- firm's market share (the firm's revenues as a percentage of the industry's total revenues in Slovenia in 1985). (Because of non-tariff barriers to inter-republican trade were introduced in the 1970s and 1980s in Yugoslavia, I assumed that the relevant market was the republic.)
- EXPSHARE -- the share of exports as a percentage of the firm's revenues.
- WOAL -- membership in a Working Organization of Associated Labor : 1 -- yes, 0 -- no (WOAL).

²⁶The following 19 industries qualified: drawn and rolled steel; cast metal products; brick production; building materials; sawmilling; board manufacturing; furniture; paper and paper products; cotton fabrics; wool fabrics; knitwear; underwear; garment; footwear; bread and pastry; vegetable and fruit processing; slaughtering; wine production; and printing. The data were obtained from Slovenia's Public Accounting Service and Statistical Office.

COAL -- membership in a Composite Organization of Associated Labor: 1 -- yes,
0 -- no (COAL).
DUM -- industry dummies.

Statistics on the above variables are summarized in table A1.

Table A1: SUMMARY STATISTICS

Variable	Mean	Coefficient of Variation (in percent)
Net value-added (Y)	1028.78	119.78
Capital (K)	867.49	151.60
Number of workers (N)	247.12	92.06
Dispersion of wages (D)	25.13	24.66
Mean-to-median earnings (m)	1.05	5.54
Education (EDUC)	9.04	11.39
Labor turnover (TURN)	2.51	111.30
Market share (MSHARE)	4.03	112.22
Export share (EXPSHARE)	15.04	109.71
Membership in a WOAL (WOAL)	.83	45.78
Membership in a COAL (COAL)	.45	111.00

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